IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

FERGUSON-PELL et al. Atty. Ref.: 117-583 (AMK)

Serial No. 10/578,558 Group: 3679

Filed: August 28, 2006 Examiner: V. MacArthur

For: ARTICULATED STRUCTURES AND MODULES THEREOF

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

DECLARATION UNDER 37 C.F.R. §1.132

Pursuant to 37 C.F.R. §1.132, Ian A. Sutherland, hereby declares and states:

1. I am currently the Director of Brunel Institute for Bioengineering, Brunel University, Uxbridge, UB8 3PH, UK.

2. I obtained degrees in Mechanical Engineering from Bristol University in 1967 (BSc) and 1971 (PhD).

3. I have practiced mechanical engineering in the aerospace industry (NASA, 1971-1973); in medical research (the National Institute for Medical Research, Engineering Division – 1973-1988); and at Brunel University as deputy-director and then director of Brunel Institute for Bioengineering from 1988 to the present day. I have had a broad range of experience over this time in the design, construction and

commercialisation of a number of different inventions, namely infusion devices, space flight hardware and centrifuges for drug purification.

4. I am currently a Fellow of the Institution of Mechanical Engineers.

5. I have reviewed and understand the subject matter of the above-captioned U.S. patent application.

6. I was asked to compare the structure and operation of the structures described and claimed in the subject application (No 10/578,558 + amendment) to the structure and operation of the devices described in U.S. Patent No. 6,219,974 to Hoberman and the devices described in U.S. Patent No. 6,425,703 to McDonnell. In addition to the patents themselves, I also worked directly with 1) a sheet of the subject flexible sheet structure; 2) two "Hoberman spheres," one small and one large which were reversible expandable structures conforming to the operation of some of the devices described in the Hoberman patent; 3) a sheet made from Meccano to simulate the scissor linkage used in the Hoberman spheres and 4) as the McDonnell pen configuration could not be found commercially, I worked with a series of pencils connected in a similarly constrained way to their Fig 1.

7. The subject invention has the novel ability to be smoothly conformed around a variety of complex shapes. For example, Figures 8, 9 and 28 show the sheet being conformed around a cylindrical shape, a hemispherical shape and the complicated shape of a spinal brace, respectively. The sheet can be formed around any one of a variety of complex shapes without adding or taking away any of the modules. This is

possible as the sheet is able to change its density, or be deformed in a fluid way, at any localised position on the sheet. An experiment to demonstrate this is illustrated in Figures A, B and C below. Figure A shows the sheet in its planar mode. The sheet is constrained at its edges as if mounted in a picture frame (later referred to as the "Picture Frame Experiment"). A tennis ball is then pressed orthogonally (at right angles) to the sheet to form a hemispherical dome (Figure B). When the tennis ball is removed, the hemispherical dome is left in the sheet with the rest of the sheet remaining as it was and undeformed (Figure C). The sheet is able to achieve this because the density of selectable portions of the sheet is variable.

8. The McDonnell patent describes a "plurality of shaft-like writing devices" that can be connected together. The writing devices include fixed ball and socket portions that facilitate pivoting and rotation. When the Picture Frame Experiment is applied to the McDonnell structure it becomes a rigid structure unable to conform to a complex shape (Figure D). When one of the constraints is removed, the McDonnell sheet of Figure 1 can be deformed around the tennis ball (Figures E & F) but forms a cylinder and cannot form to the hemispherical shape of the ball. The rigid connections between ball and socket members as well as the size and configuration of the connected writing element are structurally incapable of matching the invention as the mechanism is over-constrained and limited to move in one plane only with its sheet perpendicular to that plane. Additionally, the McDonnell sheet lacks the ability of its structure to change the density of selectable portions around complex shapes. Even when configured in a

cylinder, the density of the surface remains substantially constant because the writing elements cannot move very much towards or away from one another within the plane of the sheet.

9. The Hoberman patent describes (and the Hoberman sphere includes) a "mechanism" where every linkage is a so-called "link-pair." For the "Picture Frame Experiment," Meccano (a commercially available toy comprising metal plates with holes for attaching the plates together in a pivoting way) has been used to construct part of the Hoberman sheet illustrated in their Figures 17-19. It is observed that when any one linked pair is moved, all of the other linked-pairs move simultaneously (see the sequence from Figures G, H and J). In other words, it is a mechanism which is constrained to move in a particular way. When this sheet is constrained on each side as in the "Picture Frame Experiment," it becomes a rigid structure and cannot be deformed to conform to a complex shape. The Hoberman sheet of Figure H just sits on top of the tennis ball without being deformed (See Figures K & L). Although the density of the whole Hoberman sheet can change, it changes across the whole surface evenly and so the Hoberman sheet cannot allow a selectable portion of the sheet to have its density changed so that the sheet may be smoothly molded around complex shapes.

10. In summary, the "Picture Frame Experiment," where the rectangular sheets from the subject application and rectangular sheets from the Hoberman and McDonald patents are constrained on each of their four sides as if mounted in a picture frame, conclusively proves that only the sheet from the subject application can conform to the

shape of a tennis ball pressed in at right angles or orthogonally to the plane of the picture. Furthermore the tennis ball could be replaced by a much more complex shape – for example a tennis ball and a golf ball side by side.

11. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under the laws of the United States, Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

12th April 2010

Date

Ian A. Sutherland

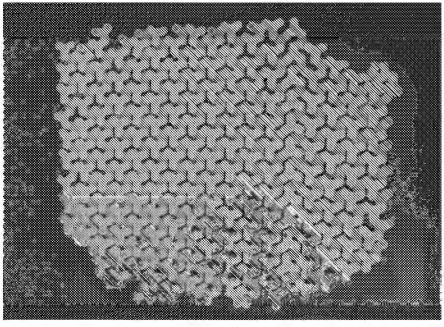

Figure A: *Subject sheet underformed and constrained on each side*

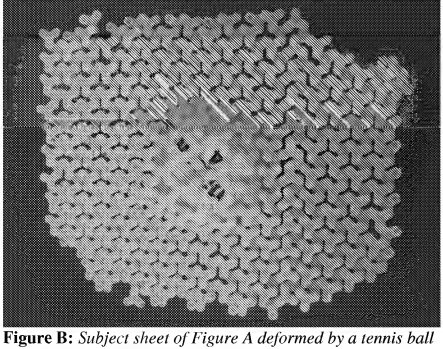

Figure B: *Subject sheet of Figure A deformed by a tennis ball*

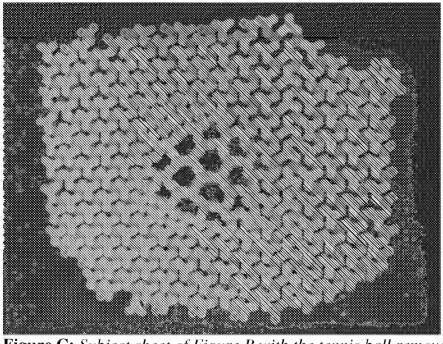

Figure C: *Subject sheet of Figure B with the tennis ball removed*

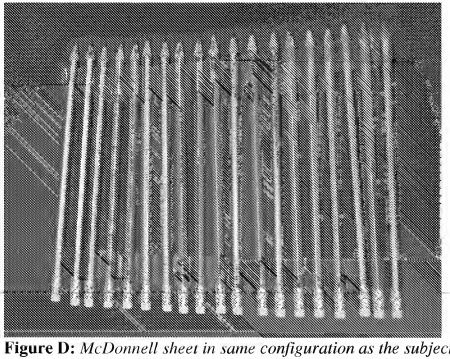

Figure D: *McDonnell sheet in same configuration as the subject sheet of Figure A*

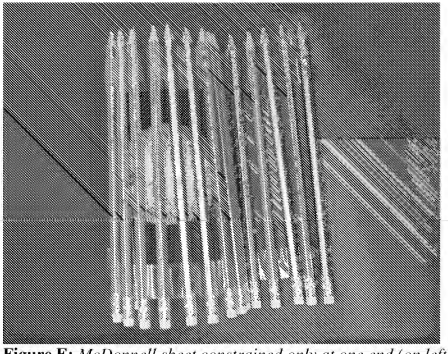

Figure E: *McDonnell sheet constrained only at one end (on left had side) deformed around a tennis ball*

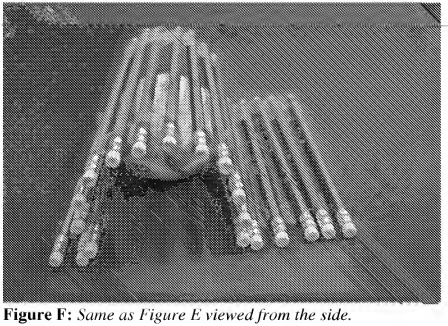

Figure F: *Same as Figure E viewed from the side.*

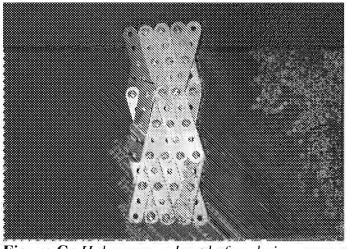

Figure G: *Hobermann sheet before being expanded from right to left*

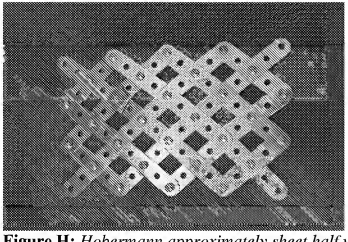

Figure H: *Hobermann approximately sheet half way through its expansion from right to left*

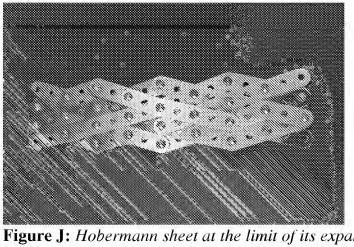

Figure J: *Hobermann sheet at the limit of its expansion from right to left.*

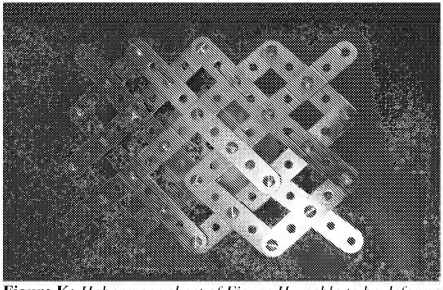

Figure K: *Hobermann sheet of Figure H unable to be deformed by the tennis ball*

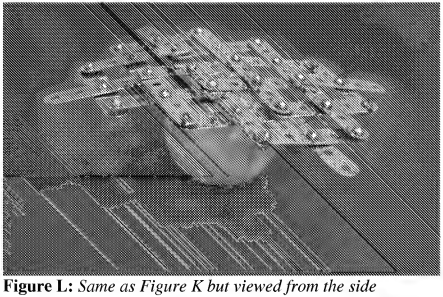

Figure L: *Same as Figure K but viewed from the side*